PBEEEP
State Government

Public Buildings Enhanced Energy Efficiency Program

Final Report
Investigation Results For
Rosemount National Guard TACC

Date: 4/5/2012

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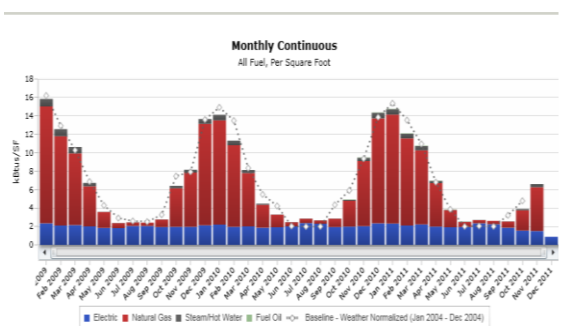
Rosemount Training and Community Center Energy Investigation Overview

The current Rosemount Training and Community Center (TACC) pneumatic climate control systems do not allow any of the proposed energy saving control strategies to be implemented. There are significant energy savings possible, but they require a building automation system (which is the standard control system for a building of this size and age). The installation of a building automation system is cost justified by the total potential energy savings in the facility.

The goal of the investigation is to identify energy savings opportunities with a payback of fifteen years or less. Particular emphasis is on finding those opportunities that will generate savings with a relatively fast (1 to 5 years) and certain payback. At the Rosemount TACC the study included a sample of spaces typical of the entire facility. The results were extrapolated to the entire facility. The reason for the limited investigation is that there is currently no centralized building automation system with equipment controls and the access to air handling units (AHU) is difficult as they are located above the ceiling. The PBEEEP Guidelines were used for all systems that were investigated and the calculations were reviewed according to PBEEEP standards. During the investigation phase the provider conducts a rigorous analysis of the system operations. Through observation, targeted functional testing, and analysis of extensive portable logger data, the RCx Provider identifies deficiencies in the operation of the mechanical equipment, lighting, envelope, and related controls. The investigation of Rosemount TACC was performed by Ericksen, Ellison and Associates, Inc. This report is the result of that information.

Payback Information and Energy Savings				
Total project costs (Without Co-funding)			**Project costs with Co-funding**	
Total costs to date including study	$32,191		Total Project Cost	$482,002
Future costs including Implementation , Measurement & Verification	$449,811		Study and Administrative Cost Paid with ARRA Funds	($32,191)
Total Project Cost	$482,002		Utility Co-funding	($12,440)
			Total costs after co-funding	$437,371
Estimated Annual Total Savings ($)	$29,291		Estimated Annual Total Savings ($)	$29,291
Total Project Payback	16.4		Total Project Payback with co-funding	14.9
Electric Energy Savings (294,120 of 789,622 kWh (2011))	**37%**	**and**	**Natural Gas Savings (14,075 of 60,672 Therms (2011))**	**23%**



STATE OF MINNESOTA B3 BENCHMARKING

Rosemount TACC Consumption Report
Total energy use was unchanged during the period of the investigation

Summary Tables

Rosemount TACC	
Location	13865 S Robert Trail, Rosemount, MN 55068
Facility Manager	Bob Jeffries
Interior Square Footage	99,522
PBEEEP Provider	Ericksen, Ellison and Associates, Inc.
Annual Energy Cost	$120,009 (2011) Source: B3
Utility Company	Xcel Energy (Electric and Natural Gas)
Site Energy Use Index (EUI)	88 kBtu/ft^2 (at start of study) 88 kBtu/ft^2 (at end of study)
Benchmark EUI (from B3)	103 kBtu/ft^2

Building Name	State ID	Area (Square Feet)	Year Built
Main Building	P01C6708001	99,522	1994

Mechanical Equipment Summary Table	
NA	Building Automation System
32	Air Handlers
71	VAV Boxes
43	Exhaust Fans
2	Chiller – Electric, Air-cooled
4	Chilled Water Pumps
2	Hot Water Boiler – Natural Gas, New Burners for dual fuel
24	Hot Water Pumps
150	Approximate number of points trended with data loggers

Implementation Information			
Estimated Annual Total Savings ($)			$29,291
Total Estimated Implementation Cost ($)			$446,811
GHG Avoided in U.S Tons (CO2e)			330
Electric Energy Savings (kWh) 37 % Savings 2011 Electric Usage 789,622 kWh (from B3)			294,120
Electric Demand Savings (Peak kW) 2 % Savings 308 kW Peak demand			6
Natural Gas Savings (Therms) 23 % Savings 2011 Natural Gas Usage 60,672 Therms from B3			14,075
Statistics			
Number of Measures identified			11
Number of Measures with payback < 3 years			1
Screening Start Date	10/22/2010	Screening End Date	11/3/2010
Investigation Start Date	6/16/2011	Investigation End Date	1/24/2012
Final Report	3/23/2012		

Rosemount TACC Cost Information			
Phase		**To date**	**Estimated**
Screening		$2,371	
Investigation [Provider]		$23,300	
Investigation [CEE]		$5,520	$1,000
Implementation			$446,811
Implementation [CEE]			$1,000
Measurement & Verification		0	$1,000
Total		$31,191	$449,811

Co-funding Summary	
Study and Administrative Cost	$32,191
Utility Co-Funding - Estimated Total ($) {prorated for this site}	$12,440
Total Co-funding ($)	$44,631

Facility Overview

The energy investigation identified eleven measures from the sample areas that extrapolate to total energy savings of 28% at Rosemount TACC with measures that payback in less than 15 years. These measures do not adversely affect occupant comfort. The energy savings opportunities identified at Rosemount TACC are based on installing a building automation system to properly control the building and installing VFDs on a number of pumps. The total cost of implementing all the measures is $446,811. It is not possible to achieve the savings without installing the entire automation system; the total implementation cost has been prorated across the individual measures (but it is not possible to only select individual measures for implementation at a partial cost).

Implementing all these measures can save the facility approximately $29,291 a year with a combined payback period of 14.8 years before rebates based on the implementation cost only (excluding study and administrative costs). After rebates the payback is reduced to 14 years. These measures will produce 37% electrical savings and 23% natural gas savings. The building is currently performing at 15% below the Minnesota Benchmarking and Beyond database (B3) benchmark value, after the installation and proper programming of an automation system it should have an EUI of about 63, 39% below the benchmark.

A sampling of air handlers was used in this study as the cost to use data loggers on all of them would have been excessive and not cost justified. The results of the investigation were extrapolated from the reported measures as shown in the table below. The actual savings and costs may be higher or lower. The savings have been estimated conservatively, and the projected energy use of the building is within the range of actual performance of other similar buildings in Minnesota (Luverne, Bloomington Rochester and Camp Ripley TACC facilities are all at this level of performance).

Finding	Finding type	Calculated Annual Savings from Study	Estimated Implemention Cost from Study	% of Building Area Represented	Total Annual Building savings	Total Implementation cost	Cost Related to Automation System
1	Fix economizers for 4 air handlers	$480	$6,500	35%	$1,371	$19,500	$14,625
2	Chilled Water Reset	$820	$10,750	100%	$820	$10,750	$5,375
3	Runtime Reduction	$3,983	$55,750	35%	$11,380	$278,750	$264,813
4	Space Setpoints	$307	$4,250	35%	$877	$21,250	$19,125
5	Occupied Setpoints	$185	$2,050	35%	$529	$10,250	$9,225
6	Low Flow Lavs	$518	$518	100%	$518	$518	$0
7	Chiller Pump Runtime	$736	$8,532	100%	$736	$8,532	$7,679
9	VFD on chilled water pumps	$1,211	$16,444	100%	$1,211	$16,444	$3,289
11	VFD on HW pumps	$4,549	$29,504	100%	$4,549	$29,504	$5,901
12	Automate lighting controls	$1,789	$8,371	35%	$5,111	$25,113	$5,023
13	Supply Air Temp Reset	$766	$8,800	35%	$2,189	$13,200	$11,200
		$15,344.00	$151,469.00		$29,291	$433,811	$346,254

The primary energy intensive systems at Rosemount TACC are described here:

The Rosemount TACC is one large building consisting of 99,522 interior square feet. The building is not controlled by a building automation system. In addition, many of the thermostatic controls are in ceiling spaces that are not accessible; as a result, temperature settings are not adjusted for days of the week or seasonal changes and set backs are not used. The building was constructed in 1994. The HVAC systems are mostly original. The occupancy varies throughout the year. The building shares its central plant with the City of Rosemount's Community Center and the utilities are prorated by the two organizations. This report concerns ONLY the part of the building used by the Department of Military Affairs.

The building contains two boilers and two chillers. There are a total of 24 hot water pumps and 4 chilled water pumps. All of these were investigated.

There are a total of 32 AHUs. Four air handlers were investigated, as is shown on the floor plan below. The spaces included were: the boiler and chiller room, the gymnasium, the main office, and a typical classroom. Each of the air handling units is separately controlled. The units are generally mounted in the ceiling space above individual rooms, and have an associated control box, including an analog time clock that is also in the ceiling space. The timers and controls are difficult to access and therefore are rarely adjusted by the staff. Because the clocks often have the incorrect time of day, the spaces tend to be set for a constant temperature 24 hours a day, seven days a week. There are approximately 71 VAV boxes associated with these AHUs, most of the VAVs contain reheats.

The site Energy Use Index (EUI) for the building is 88 kBtu/ft^2, which is 15% lower than the B3 Benchmark of 103 kBtu/ft^2.

Main Floor of Rosemount Training and Community Center, showing areas investigated in the PBEEEP Study (blue shading).

Findings Summary

PBEEEP State Government

Building: Rosemount TACC
Site: Rosemount TACC

Eco #	Investigation Finding	Total Cost	Savings	Payback	Co-Funding	Payback Co-Funding	GHG
6	Install low-flow lavitory aerators	$315	$518	0.61	$0	0.61	4
12	Existing spaces have manual lighting control.	$8,371	$1,789	4.68	$0	4.68	18
11	VFD on hot water pumps	$29,504	$4,549	6.49	$0	6.49	69
5	Adjust Occupied Setpoint	$2,050	$185	11.06	$0	11.06	2
13	No supply temperature reset	$8,800	$766	11.48	$0	11.48	7
7	Reduce chilled water pump runtime	$8,532	$736	11.60	$0	11.60	11
2	Implement chilled water reset schedule	$10,750	$820	13.11	$0	13.11	10
1	Correct economizer operation	$6,500	$480	13.55	$0	13.55	6
9	VFD on chilled water pumps	$16,444	$1,211	13.58	$0	13.58	18
4	Adjust Unoccupied Setpoint	$4,250	$307	13.82	$0	13.82	3
3	Adjust Air Handler Runtime	$55,750	$3,983	14.00	$0	14.00	41
	Total for Findings with Payback 3 years or less:	**$315**	**$518**	**0.61**	**$0**	**0.61**	**4**
	Total for all Findings:	**$151,266**	**$15,344**	**9.86**	**$0**	**9.86**	**189**

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

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Rev. 2.0 (12/16/2010)

13700 - Rosemount TACC

This checklist is designed to be a resource and reference for Providers and PBEEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
a. Equipment Scheduling and Enabling:	a.1 (1)	Time of Day enabling is excessive	AHUs have no occupied/unoccupied schedules	Multiple AHUs		
	a.2 (2)	Equipment is enabled regardless of need, or such enabling is excessive	CHWP is on when not needed	CHWP-1, CHWP-2		
	a.3 (3)	Lighting is on more hours than necessary.	Lights with manual controls	Throughout building		
	a.4 (4)	OTHER_Equipment Scheduling/Enabling	N/A	N/A	Not Relevant	No additional "Other" equipment not addressed by other Findings in category
b. Economizer/Outside Air Loads:	b.1 (5)	Economizer Operation – Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)	AHU have no economizer or not optimised	Multiple AHUs		
	b.2 (6)	Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.	AHUs bring in more OSA than needed	Multiple AHUs		After adjustments based on comments from CEE this no longer pays back within the PBEEEP program period.
	b.3 (7)	OTHER_Economizer/OA Loads	N/A	N/A	Not Relevant	No Additional OSA/Economizer Equipment
c. Controls Problems:	c.1 (8)	Simultaneous Heating and Cooling is present and excessive	N/A	N/A	Investigation looked for, but did not find this issue.	
	c.2 (9)	Sensor/Thermostat needs calibration, relocation/shielding, and/or replacement	N/A	N/A	Investigation looked for, but did not find this issue.	
	c.3 (10)	Controls "hunt" and/or need Loop Tuning or separation of heating/cooling setpoints	N/A	N/A	Investigation looked for, but did not find this issue.	
	c.4 (11)	OTHER_Controls	N/A	N/A	Investigation looked for, but did not find this issue.	No additional "Other" controls not addressed by other Findings in category
d. Controls (Setpoint Changes):	d.1 (12)	Daylighting controls or occupancy sensors need optimization.	N/A	N/A	Investigation looked for, but did not find this issue.	This is addressed as part of a.3(3) Lighting is on more hours than necessary.
	d.2 (13)	Zone setpoint setup/setback are not implemented or are sub-optimal.	AHUs have no occupied/unoccupied schedules	Multiple AHUs		
	d.3 (14)	Fan Speed Doesn't Vary Sufficiently	N/A	N/A	Investigation looked for, but did not find this issue.	
	d.4 (15)	Pump Speed Doesn't Vary Sufficiently	N/A	N/A	Not Relevant	No variable speed pumps at facility
	d.5 (16)	VAV Box Minimum Flow Setpoint is higher than necessary	N/A	N/A	Investigation looked for, but did not find this issue.	
	d.6 (17)	Other_Controls (Setpoint Changes)	N/A	N/A	Not Relevant	No additional "Other" controls not addressed by other Findings in category
e. Controls (Reset Schedules):	e.1 (18)	HW Supply Temperature Reset is not implemented or is sub-optimal	N/A	N/A	Investigation looked for, but did not find this issue.	The facility appears to have some sort of summer/winter reset in place. However, with the warm weather we cannot properly verify that. The trends show that we cannot reduced the water temperature any further due to possible condensation in the boilers.
	e.2 (19)	CHW Supply Temperature Reset is not implemented or is sub-optimal	No chilled water reset in place	Chiller 1, Chiller 2		
	e.3 (20)	Supply Air Temperature Reset is not implemented or is sub-optimal	AHUs have a heating/cooling temp but no reset	Multiple AHUs		
	e.4 ( )	Supply Duct Static Pressure Reset is not implemented or is sub-optimal	N/A	N/A	Investigation looked for, but did not find this issue.	Without a BMS with full control of the individual VAV boxes, this can not be calculated.
	e.5 (21)	Condenser Water Temperature Reset is not implemented or is sub-optimal	N/A	N/A	Not Relevant	No condenser water at facility.
	e.6 (22)	Other_Controls (Reset Schedules)	N/A	N/A	Not Relevant	No additional "Other" equipment not addressed by other Findings in category
f. Equipment Efficiency Improvements / Load Reduction:	f.1 (23)	Daylighting Control needs optimization—Spaces are Over-Lit	N/A	N/A	Investigation looked for, but did not find this issue.	
	f.2 (24)	Pump Discharge Throttled	N/A	N/A	Investigation looked for, but did not find this issue.	When we investigated the site, any valves we saw in the mechanical room were fully open. It's possible that these valves can (and have) been changed in the time since our last visit. As part of the installation of ASDs on the heating and chilled water pumps, any triple duty valves would be removed (the ASDs would be used for flow control).
	f.3 (25)	Over-Pumping	N/A	N/A	Investigation looked for, but did not find this issue.	Any over-pumping is being addressed by adding VFDs.

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13700 - Rosemount TACC

This checklist is designed to be a resource and reference for Providers and PBEEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
	f.4 (26)	Equipment is oversized for load.	N/A	N/A	Investigation looked for, but did not find this issue.	
	f.5 (27)	OTHER_Equipment Efficiency/Load Reduction	N/A	N/A	Not Relevant	No additional "Other" equipment not addressed by other Findings in category
g. Variable Frequency Drives (VFD):	**g.1 (28)**	VFD Retrofit - Fans	N/A	N/A	Not cost-effective to investigate	Payback for adding VFDs to CV air handlers falls outside of PBEEEP program requirements.
	g.2 (29)	VFD Retrofit - Pumps	Multiple CV pumps that could use VFD	Hot water pumps & secondary chilled water pumps		
	g.3 (30)	VFD Retrofit - Motors (process)	N/A	N/A	Not Relevant	No process motors on site
	g.4 (31)	OTHER_VFD	N/A	N/A	Not Relevant	No other equipment that could utilize VFD
h. Retrofits:	**h.1 (32)**	Retrofit - Motors	N/A	N/A	Investigation looked for, but did not find this issue.	Payback for retrofitting motors is beyond 15 years.
	h.2 (33)	Retrofit - Chillers	N/A	N/A	Not cost-effective to investigate	Payback for retrofitting chillers is beyond 15 years.
	h.3 (34)	Retrofit - Air Conditioners (Air Handling Units, Packaged Unitary Equipment)	N/A	N/A	Not Relevant	No air conditioners on site. Cooling provided by air cooled chiller.
	h.4 (35)	Retrofit - Boilers	N/A	N/A	Not cost-effective to investigate	Existing boiler were just updated with dual fuel (gas/propane) burners.
	h.5 (36)	Retrofit - Packaged Gas fired heating	N/A	N/A	Investigation looked for, but did not find this issue.	Boilers are as efficient as avilable for dual fuel. Exact domestic hot water usage is not available, therefore we cannot calculate dmestic water heater retofit to PBEEEP program standards.
	h.6 (37)	Retrofit - Heat Pumps	N/A	N/A	Not Relevant	No heat pumps on site
	h.7 (38)	Retrofit - Equipment (custom)	N/A	N/A	Not Relevant	No custom equipment on site
	h.8 (39)	Retrofit - Pumping distribution method	N/A	N/A	Not cost-effective to investigate	
	h.9 (40)	Retrofit - Energy/Heat Recovery	Boiler Flue Economizer	Boiler system		
	h.10 (41)	Retrofit - System (custom)	N/A	N/A	Not Relevant	No custom systems on site
	h.11 (42)	Retrofit - Efficient Lighting	N/A	N/A	Investigation looked for, but did not find this issue.	
	h.12 (43)	Retrofit - Building Envelope	N/A	N/A	Not cost-effective to investigate	
	h.13 (44)	Retrofit - Alternative Energy	N/A	N/A	Not cost-effective to investigate	Quick calculations put the payback well beyond the 15 year guideline.
	h.14 (45)	OTHER_Retrofit	N/A	N/A	Not Relevant	No OTHER equipment on site
i. Maintenance Related Problems:	**i.1 (46)**	Differed Maintenance from Recommended/Standard	N/A	N/A	Investigation looked for, but did not find this issue.	
	i.2 (47)	Impurity/Contamination	N/A	N/A	Investigation looked for, but did not find this issue.	
	i.3 ( )	Leaky/Stuck Damper	N/A	N/A	Investigation looked for, but did not find this issue.	The dampers in question appear to close properly (and seal). The issue is that the economizer sequence isn't working properly. Access to dampers at this facility is extremely limited. The air handlers themselves are completely closed. Trending of the pneumatically controlled VAV box dampers was not possible. With the installation of a building wide BAS, all of the dampers (including those in the VAV boxes) would be examined and justed/repaired/replaced as necessary to provide a fully functioning system.
	i.4 ( )	Leaky/Stuck Valve	N/A	N/A	Investigation looked for, but did not find this issue.	
	i.5 (48)	OTHER_Maintenance	N/A	N/A	Investigation looked for, but did not find this issue.	
j. OTHER	**j.1 (49)**	OTHER	N/A	N/A	Investigation looked for, but did not find this issue.	

Findings Glossary: Examples of Common Findings Details (Reference)

a.1 (1)	**Time of Day enabling is excessive**
	• HVAC running when building is unoccupied. Equipment schedule doesn't follow building occupancy • Optimum start-stop is not implemented • Controls in hand
a.2 (2)	**Equipment is enabled regardless of need, or such enabling is excessive**
	• Fan runs at 2" static pressure. Lowering pressure to 1.8" does not create comfort problem and the flow is per design. • Supply air temperature and pressure reset: cooling and heating
a.3 (3)	**Lighting is on more hours than necessary**
	• Lighting is on at night when the building is unoccupied • Photocells could be used to control exterior lighting • Lighting controls not calibrated/adjusted properly
a.4 (4)	**OTHER Equipment Scheduling and Enabling**
	• Please contact PBEEEP Project Engineer for approval
b.1 (5)	**Economizer Operation – Inadequate Free Cooling**
	• Economizer is locked out whenever mechanical cooling is enabled (non-integrated economizer) • Economizer linkage is broken • Economizer setpoints could be optimized • Plywood used as the outdoor air control • Damper failed in minimum or closed position
b.2 (6)	**Over-Ventilation**
	• Demand-based ventilation control has been disabled • Outside air damper failed in an open position • Minimum outside air fraction not set to design specifications or occupancy
b.3 (7)	**OTHER Economizer/Outside Air Loads**
	• Please contact PBEEEP Project Engineer for approval
c.1 (8)	**Simultaneous Heating and Cooling is present and excessive**
	• For a given zone, CHW and HW systems are unnecessarily on and running simultaneously • Different setpoints are used for two systems serving a common zone
c.2 (9)	**Sensor / Thermostat needs calibration, relocation / shielding, and/or replacement**
	• OAT temperature is reading 5 degrees high, resulting in loss of useful economizer operation • Zone sensors need to be relocated after tenant improvements • OAT sensor reads high in sunlight
c.3 (10)	**Controls "hunt" / need Loop Tuning or separation of heating/cooling setpoints**
	• CHW valve cycles open and closed • System needs loop tuning – it is cycling between heating and cooling
c.4 (11)	**OTHER Controls**
	• Please contact PBEEEP Project Engineer for approval
d.1 (12)	**Daylighting controls or occupancy sensors need optimization**
	• Existing controls are not functioning or overridden • Light sensors improperly placed or out of calibration
d.2 (13)	**Zone setpoint setup / setback are not implemented or are sub-optimal**
	• The cooling setpoint is 74 ºF 24 hours per day
d.3 (14)	**Fan Speed Doesn't Vary Sufficiently**
	• Fan runs at 2" static pressure. Lowering pressure to 1.8" does not create comfort problem and the flow is per design. • Supply air temperature and pressure reset: cooling and heating

d.4 (15)	**Pump Speed Doesn't Vary Sufficiently**	
		• Pump runs at 15 PSI on peak day. Lowering pressure to 12 does not create comfort problem and the flow is per design. Low ΔT across the chiller during low load conditions.
d.5 (16)	**VAV Box Minimum Flow Setpoint is higher than necessary**	
		• Boxes universally set at 40%, regardless of occupancy. Most boxes can have setpoints lowered and still meet minimum airflow requirements.
d.6 (17)	**Other Controls (Setpoint Changes)**	
		• Please contact PBEEEP Project Engineer for approval
e.1 (18)	**HW Supply Temperature Reset is not implemented or is sub-optimal**	
		• HW supply temperature is a constant 180 ºF. It should be reset based on demand, or decreased by a reset schedule as OAT increases. • DHW Setpoints are constant 24 hours per day
e.2 (19)	**CHW Supply Temperature Reset is not implemented or is sub-optimal**	
		• CHW supply temperature is a constant 42 ºF. It could be reset, based on demand or ambient temperature.
e.3 (20)	**Supply Air Temperature Reset is not implemented or is sub-optimal**	
		• The SAT is constant at 55 ºF. It could be reset to minimize reheat and maximize economizer cooling. The reset should ideally be based on demand (e.g., looking at zone box damper positions), but could also be reset based on OAT.
e.4 ( )	**Supply Duct Static Pressure Reset is not implemented or is suboptimal**	
		• The Duct Static Pressure (DSP) is constant at 1.5" wc. It could be reset to minimize fan energy. The reset should ideally be based on demand (e.g. looking at zone box damper positions), but could also be reset based on OAT.
e.5 (21)	**Condenser Water Temperature Reset is not implemented or is sub-optimal**	
		• CW temperature is constant leaving the tower at 85 ºF. The temperature should be reduced to minimize the total energy use of the chiller and tower. It may be worthwhile to reset based on load and ambient conditions.
e.6 (22)	**Other Controls (Reset Schedules)**	
		• Please contact PBEEEP Project Engineer for approval
f.1 (23)	**Lighting system needs optimization - Spaces are overlit**	
		• Lighting exceeds ASHRAE or IES standard levels for specific space types or tasks
f.2 (24)	**Pump Discharge Throttled**	
		• The discharge valve for the CHW pump is 30% open. The valve should be opened and the impeller size reduced to provide the proper flow without throttling.
f.3 (25)	**Over-Pumping**	
		• Only one CHW pump runs when one chiller is running. However, due to the reduced pressure drop in the common piping, the pump is providing much greater flow than needed.
f.4 (26)	**Equipment is oversized for load**	
		• The equipment cycles unnecessarily • The peak load is much less than the installed equipment capacity

f.5 (27)	**OTHER Equipment Efficiency/Load Reduction**	
		• Please contact PBEEEP Project Engineer for approval
g.1 (28)	**VFD Retrofit Fans**	
		• Fan serves variable flow system, but does not have a VFD. • VFD is in override mode, and was found to be not modulating.
g.2 (29)	**VFD Retrofit - Pumps**	
		• 3-way valves are used to maintain constant flow during low load periods. • Only one CHW pumps runs when one chiller is running. However, due to the reduced pressure drop in the common piping, the pump is providing much greater flow than needed.
g.3 (30)	**VFD Retrofit - Motors (process)**	
		• Motor is constant speed and uses a variable pitch sheave to obtain speed control.
g.4 (31)	**OTHER VFD**	
		• Please contact PBEEEP Project Engineer for approval
h.1 (32)	**Retrofit - Motors**	
		• Efficiency of installed motor is much lower than efficiency of currently available motors
h.2 (33)	**Retrofit - Chillers**	
		• Efficiency of installed chiller is much lower than efficiency of currently available chillers
h.3 (34)	**Retrofit - Air Conditioners (Air Handling Units, Packaged Unitary Equipment)**	
		• Efficiency of installed air conditioner is much lower than efficiency of currently available air conditioners
h.4 (35)	**Retrofit - Boilers**	
		• Efficiency of installed boiler is much lower than efficiency of currently available boilers
h.5 (36)	**Retrofit - Packaged Gas-fired heating**	
		• Efficiency of installed heaters is much lower than efficiency of currently available heaters
h.6 (37)	**Retrofit - Heat Pumps**	
		• Efficiency of installed heat pump is much lower than efficiency of currently available heat pumps
h.7 (38)	**Retrofit - Equipment (custom)**	
		• Efficiency of installed equipment is much lower than efficiency of currently available equipment
h.8 (39)	**Retrofit - Pumping distribution method**	
		• Current pumping distribution system is inefficient, and could be optimized. • Pump distribution loop can be converted from primary to primary-secondary)
h.9 (40)	**Retrofit - Energy / Heat Recovery**	
		• Energy is not recouped from the exhaust air. • Identification of equipment with higher effectiveness than the current equipment.
h.10 (41)	**Retrofit - System (custom)**	
		• Efficiency of installed system is much lower than efficiency of another type of system
h.11 (42)	**Retrofit - Efficient lighting**	
		• Efficiency of installed lamps, ballasts or fixtures are much lower than efficiency of currently available lamps, ballasts or fixtures.

h.12 (43)	**Retrofit - Building Envelope**	
		• Insulation is missing or insufficient • Window glazing is inadequate • Too much air leakage into / out of the building • Mechanical systems operate during unoccupied periods in extreme weather
h.13 (44)	**Retrofit - Alternative Energy**	
		• Alternative energy strategies, such as passive/active solar, wind, ground sheltered construction or other alternative, can be incorporated into the building design
h.14 (45)	**OTHER Retrofit**	
		• Please contact PBEEEP Project Engineer for approval
i.1 (46)	**Differed Maintenance from Recommended/Standard**	
		• Differed maintenance that results in sub-optimal energy performance. • Examples: Scale buildup on heat exchanger, broken linkages to control actuator missing equipment components, etc.
i.2 (47)	**Impurity/Contamination**	
		• Impurities or contamination of operating fluids that result in sub-optimal performance. Examples include lack of chemical treatment to hot/cold water systems that result in elevated levels of TDS which affect energy efficiency.
i.3 ( )	**Leaky/Stuck Damper**	
		• The outside or return air damper on an AHU is leaking or is not modulating causing the energy use go up because of additional load to the central heating and/or cooling plant.
i.4 ( )	**Leaky/Stuck Valve**	
		• The heating or cooling coil valve on an AHU is leaking or is not modulating causing the energy use go up because of additional load to the central heating and/or cooling plant.
i.5 (48)	**OTHER Maintenance**	
		• Please contact PBEEEP Project Engineer for approval
j.1 (49)	**OTHER**	
		• Please contact PBEEEP Project Engineer for approval

Findings Details

Building: Rosemount TACC

FWB Number:	13700	Eco Number:	1
Site:	Rosemount TACC	Date/Time Created:	4/5/2012

Investigation Finding:	Correct economizer operation	Date Identified:	11/15/2011
Description of Finding:	Currently, the air handling system introduces only the minimum amount of outdoor air to the spaces it serves to meet the minimum code requirement for outdoor ventilation air. The system does not have provisions to introduce a larger amount of outdoor air to provide atmospheric cooling (economizer operation). Mechanical cooling is therefore required to drop the supply air temperature to the desired temperature. The equipment affected is: Office (AHU-16), Gym North (AHU-20), Gym North (AHU-21), Conference Room (AHU-15)		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Economizer/Outside Air Loads
Finding Type:	Economizer Operation - Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)		

Implementer:	Contractor	Benefits:	Increasing the OSA intake when conditions merit reduces the required amount of mechanical cooling and saves energy.
Baseline Documentation Method:	Trend data for the affected equipment (AHU-16, AHU-20, AHU-21, AHU-15) during summer and fall (Conference Room – Summer.xls, Gym – Summer.xls, Office – Summer.xls, Conference Room – Fall.xls, Gym – Fall.xls, Office – Fall.xls) shows that these units do not properly economize.		
Measure:	Correct and re-implement the economizer sequence for the affected air handlers.		
Recommendation for Implementation:	Make the following provisions to allow up to 100% outdoor air to be introduced, to the extent it is beneficial to accomplish atmospheric cooling and replace mechanical cooling. The system will operate according to a programmed airside economizer sequence to maintain the desired temperatures, up to the high limit of outdoor air temperature.		
Evidence of Implementation Method:	Verification of Implementation shall require: The following trend logs of each of the affected air handlers (AHU-16, AHU-20, AHU-21, AHU-15) shall be taken on 15 minute intervals 2 week(s) during swing season (40ºF < OSA temp < 80ºF) and for 2 week(s) during the cooling season (OSA temp >80ºF) to verify that the new economizer set point is maintained: OSA Damper Position, OSA Temperature, Return Air Temperature, Mixed Air Temperature, Supply Fan Status/Speed.		

Annual Electric Savings (kWh):	6,800	Contractor Cost ($):	$5,750
Estimated Annual kWh Savings ($):	$480	PBEEEP Provider Cost for Implementation Assistance ($):	$750
		Total Estimated Implementation Cost ($):	$6,500

Estimated Annual Total Savings ($):	$480	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	13.55	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	13.55	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	6	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	3.1%	Percent of Implementation Costs:	4.3%

Findings Details

Building: Rosemount TACC

FWB Number:	13700	Eco Number:	2
Site:	Rosemount TACC	Date/Time Created:	4/5/2012

Investigation Finding:	Implement chilled water reset schedule	Date Identified:	11/15/2011
Description of Finding:	Currently the air cooled chillers do not have a reset schedule for the chilled water. During periods of low cooling requirements, the chilled water supply temperature could be raised and still meet the load requirement. The chilled water shall reset linearly between 44ºF and 50ºF when the OSA temperature is between 85ºF and 45ºF. A chiller operating at a higher chilled water temperature is more efficient. The equipment affected is: Chiller 1, Chiller 2		
Equipment or System(s):	Chiller Plant	Finding Category:	Controls (Reset Schedules)
Finding Type:	CHW Supply Temperature Reset is not implemented or is sub-optimal		

Implementer:	Contractor	Benefits:	Increasing the chilled water temperature when the load on the building is low (when the outside temperature is lower) saves energy.
Baseline Documentation Method:	Trend data of the chilled water temperatures during the summer and fall (Boilerroom – Summer.xls, Boilerroom – Fall.xls, Chiller Loads.xls) show that the chilled water temperature doesn't vary.		
Measure:	Implement a chilled water temperature reset.		
Recommendation for Implementation:	The Contractor shall implement a chilled water supply temperature reset based on the outside air temperature. The chilled water temperature set point shall linearly vary between the following two points. When the OSA temperature is 85ºF the chilled water temperature shall be 45ºF. When the OSA temperature is 55ºF the chilled water temperature shall be 50ºF.		
Evidence of Implementation Method:	Verification of Implementation shall require: The following trend logs of each of the chilled water system shall be taken on 15 minute intervals 2 week(s) during swing season (40ºF < OSA temp < 80ºF) and for 2 week(s) during the cooling season (OSA temp >80ºF) to verify that the new economizer set point is maintained: OSA Temperature, Chilled Water Supply Temperature, Chilled Water Return Temperature, Chiller 1 Status, Chiller 2 Status.		

Annual Electric Savings (kWh): Estimated Annual kWh Savings ($):	12,039 $704	Peak Demand Savings (kWh): Estimated Annual Demand Savings ($):	6 $116
Contractor Cost ($): PBEEEP Provider Cost for Implementation Assistance ($): Total Estimated Implementation Cost ($):	$10,000 $750 $10,750		

Estimated Annual Total Savings ($):	$820	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	13.11	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	13.11	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	10	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	5.3%	Percent of Implementation Costs:	7.1%

Findings Details

PBEEEP State Government

Building: Rosemount TACC

FWB Number:	13700	Eco Number:	3
Site:	Rosemount TACC	Date/Time Created:	4/5/2012

Investigation Finding:	Adjust Air Handler Runtime	Date Identified:	11/15/2011
Description of Finding:	Multiple pieces of equipment operate 24hours a day or operate on an occupied/unoccupied schedule that is excessive and does not represent actual occupied hours. Equipment Affected: AHU-15, AHU-16, AHU-20, AHU-21, AHU-25		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Equipment Scheduling and Enabling
Finding Type:	Time of Day enabling is excessive		

Implementer:	Contractor	Benefits:	Reduced runtime will save energy
Baseline Documentation Method:	Trending of the air handlers and space temperatures (Conference Room – Summer.xls, Gym – Summer.xls, Office – Summer.xls, Classroom – Summer.xls, Conference Room – Fall.xls, Gym – Fall.xls, Office – Fall.xls, Classroom – Fall.xls) and information on equipment schedules pulled from the BMS indicate what the units are currently doing for occupied/unoccupied temperatures and schedules. Discussions with the Owner determined the correct occupied/unoccupied schedule for the space. (See 13700 Rosemount TACC Equipment Schedules.xls)		
Measure:	Adjust equipment schedules to match actuall occupied periods		
Recommendation for Implementation:	Adjust BMS programming to allow for an occupied/unoccupied schedule that matches the facilities actual occupied hours. See 13700 Rosemount TACC Equipment Schedules.xls		
Evidence of Implementation Method:	Verification of Implementation shall require: The following trend logs of each of the affected air handlers (AHU-15, AHU-16, AHU-20, AHU-21, AHU-25) shall be taken on 15 minute intervals 2 week(s) during heating season (OSA temp <40ºF) and for 2 week(s) during the cooling season (OSA temp >80ºF) to verify that the air handlers are properly changing modes (occupied/unoccupied): Supply Fan Speed/Status, Space Temperature, Heating Valve Position, Cooling Valve Position, OSA Damper Position		

Annual Electric Savings (kWh): Estimated Annual kWh Savings ($):	22,569 $1,238	Annual Natural Gas Savings (therms): Estimated Annual Natural Gas Savings ($):	3,845 $2,745
Contractor Cost ($): PBEEEP Provider Cost for Implementation Assistance ($): Total Estimated Implementation Cost ($):	$55,000 $750 $55,750		

Estimated Annual Total Savings ($):	$3,983	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	14.00	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	14.00	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	41	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	26.0%	Percent of Implementation Costs:	36.9%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

Building: Rosemount TACC

FWB Number:	13700	Eco Number:	4
Site:	Rosemount TACC	Date/Time Created:	4/5/2012

Investigation Finding:	Adjust Unoccupied Setpoint	Date Identified:	11/15/2011
Description of Finding:	Multiple pieces of equipment operate 24hours a day or operate on an occupied/unoccupied schedule that is excessive and does not represent actual occupied hours. Equipment Affected: AHU-15, AHU-16, AHU-20, AHU-21, AHU-25		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Controls (Setpoint Changes)
Finding Type:	Zone setpoint setup/setback are not implemented or are sub-optimal		

Implementer:	Contractor	Benefits:	Corrected unoccupied setpoint will save energy
Baseline Documentation Method:	Trending of the air handlers and space temperatures (Conference Room – Summer.xls, Gym – Summer.xls, Office – Summer.xls, Classroom – Summer.xls, Conference Room – Fall.xls, Gym – Fall.xls, Office – Fall.xls, Classroom – Fall.xls) and information on equipment schedules pulled from the BMS indicate what the units are currently doing for occupied/unoccupied temperatures and schedules. Discussions with the Owner determined the correct occupied/unoccupied schedule for the space. (See 13700 Rosemount TACC Equipment Schedules.xls)		
Measure:	Adjust equipment schedules to correct unoccpied setpoint.		
Recommendation for Implementation:	Adjust BMS programming to allow for an occupied/unoccupied schedule that matches the facilities actual occupied hours. See 13700 Rosemount TACC Equipment Schedules.xls		
Evidence of Implementation Method:	Verification of Implementation shall require: The following trend logs of each of the affected air handlers (AHU-15, AHU-16, AHU-20, AHU-21, AHU-25) shall be taken on 15 minute intervals 2 week(s) during heating season (OSA temp <40ºF) and for 2 week(s) during the cooling season (OSA temp >80ºF) to verify that the air handlers are properly changing modes (occupied/unoccupied): Supply Fan Speed/Status, Space Temperature, Heating Valve Position, Cooling Valve Position, OSA Damper Position		

Annual Electric Savings (kWh):	1,722	Annual Natural Gas Savings (therms):	297
Estimated Annual kWh Savings ($):	$96	Estimated Annual Natural Gas Savings ($):	$212
Contractor Cost ($):	$3,500		
PBEEEP Provider Cost for Implementation Assistance ($):	$750		
Total Estimated Implementation Cost ($):	$4,250		

Estimated Annual Total Savings ($):	$307	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	13.82	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	13.82	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	3	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	2.0%	Percent of Implementation Costs:	2.8%

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Findings Details

PBEEEP State Government

Building: Rosemount TACC

FWB Number:	13700	Eco Number:	5
Site:	Rosemount TACC	Date/Time Created:	4/5/2012

Investigation Finding:	Adjust Occupied Setpoint	Date Identified:	11/15/2011
Description of Finding:	Multiple pieces of equipment operate 24hours a day or operate on an occupied/unoccupied schedule that is excessive and does not represent actual occupied hours. Equipment Affected: AHU-15, AHU-16, AHU-20, AHU-21, AHU-25		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Controls (Setpoint Changes)
Finding Type:	Zone setpoint setup/setback are not implemented or are sub-optimal		

Implementer:	Contractor	Benefits:	Corrected occupied setpoint will save energy
Baseline Documentation Method:	Trending of the air handlers and space temperatures (Conference Room – Summer.xls, Gym – Summer.xls, Office – Summer.xls, Classroom – Summer.xls, Conference Room – Fall.xls, Gym – Fall.xls, Office – Fall.xls, Classroom – Fall.xls) and information on equipment schedules pulled from the BMS indicate what the units are currently doing for occupied/unoccupied temperatures and schedules. Discussions with the Owner determined the correct occupied/unoccupied schedule for the space. (See 13700 Rosemount TACC Equipment Schedules.xls)		
Measure:	Adjust equipment schedules to correct occupied setpoint		
Recommendation for Implementation:	Adjust BMS programming to allow for an occupied/unoccupied schedule that matches the facilities actual occupied hours. See 13700 Rosemount TACC Equipment Schedules.xls		
Evidence of Implementation Method:	Verification of Implementation shall require: The following trend logs of each of the affected air handlers (AHU-15, AHU-16, AHU-20, AHU-21, AHU-25) shall be taken on 15 minute intervals 2 week(s) during heating season (OSA temp <40ºF) and for 2 week(s) during the cooling season (OSA temp >80ºF) to verify that the air handlers are properly changing modes (occupied/unoccupied): Supply Fan Speed/Status, Space Temperature, Heating Valve Position, Cooling Valve Position, OSA Damper Position		

Annual Electric Savings (kWh):	2,406	Annual Natural Gas Savings (therms):	-30
Estimated Annual kWh Savings ($):	$207	Estimated Annual Natural Gas Savings ($):	$-21
Contractor Cost ($):	$1,300		
PBEEEP Provider Cost for Implementation Assistance ($):	$750		
Total Estimated Implementation Cost ($):	$2,050		

Estimated Annual Total Savings ($):	$185	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	11.06	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	11.06	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	2	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	1.2%	Percent of Implementation Costs:	1.4%

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Findings Details

Building: Rosemount TACC

FWB Number:	13700	Eco Number:	6
Site:	Rosemount TACC	Date/Time Created:	4/5/2012

Investigation Finding:	Install low-flow lavitory aerators	Date Identified:	11/15/2011
Description of Finding:	Lavatory faucets at the facility do not utilize low flow aerators. Because of this, the lavatories at the facility use more hot water than necessary. If the hot water use is reduced, the energy required to heat the water can be reduced. The current lavatories are manually controlled models. The current lavatory flow rate is based on inspection of the existing lavatory aerators.		
Equipment or System(s):	Other	Finding Category:	Retrofits
Finding Type:	Other Retrofit		

Implementer:	Contractor	Benefits:	Lower hot water flow will save energy on hot water heating.
Baseline Documentation Method:	During a site visit, aerators for 50% of the lavatories at the facility were inspected and found to be 2.2 GPM flow style.		
Measure:	Replace the aerators with lower flow models		
Recommendation for Implementation:	Replace the aerator in each lavatory faucet with a low flow (1.0 GPM) aerator. There are 21 total public lavatories at the facility.		
Evidence of Implementation Method:	A visual inspection of the lavatories will show that the aerators have been properly replaced with lower flow aerators.		

Annual Natural Gas Savings (therms):	726	Contractor Cost ($):	$315
Estimated Annual Natural Gas Savings ($):	$518	PBEEEP Provider Cost for Implementation Assistance ($):	$0
		Total Estimated Implementation Cost ($):	$315

Estimated Annual Total Savings ($):	$518	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.61	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.61	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	4	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	3.4%	Percent of Implementation Costs:	0.2%

Findings Details

Building: Rosemount TACC

FWB Number:	13700	Eco Number:	7
Site:	Rosemount TACC	Date/Time Created:	4/5/2012

Investigation Finding:	Reduce chilled water pump runtime	Date Identified:	12/1/2011
Description of Finding:	Currently one of the primary chilled water pumps is left running 24 hours a day through the winter (only 1 pump ever runs as they are fully redundant). This is done to help prevent the chilled water in the chiller from freezing during low temperatures. However, the original system was designed for a 30% glycol solution in the chilled water. This is enough to prevent the water in the chiller from freezing during the winter. Equipment Affected:CHWP-1, CHWP-2 (only one pump operates at a time)		
Equipment or System(s):	Pump, secondary CHW (distr-only or evap and distr)	Finding Category:	Equipment Scheduling and Enabling
Finding Type:	Equipment is enabled regardless of need, or such enabling is excessive		

Implementer:	Contractor	Benefits:	Reduced runtime will save energy
Baseline Documentation Method:	Trend data of the chilled water pumps (Boilerroom – Summer.xls, Boilerroom – Fall.xls, Boiler Room – November.xls) and discussion with the Owner indicate that the primary chilled water pump (either CHWP-1 or CHWP-2) is left running during the winter. This was done for freeze protection, but is unnecessary as the chilled water loop is comprised of 30% glycol.		
Measure:	Replace the chilled water with a proper water/glycol mix and ensure the pump is deactivated as part of the winter shutdown sequence.		
Recommendation for Implementation:	The Contractor shall sample the existing chilled water solution and determine the level of freeze protection and condition of the solution. The Contractor shall drain the existing chilled water system (existing fluid is of unknown age and concentration) and properly dispose of the waste. The Contractor shall refill the chilled water system with a premixed solution of 30% propylene glycol and water (approximately 1,200 gallons). The Owner will ensure that deactivation of this pump is added to the standard summer to winter changeover procedure.		
Evidence of Implementation Method:	Verification of Implementation shall require: The following trend logs of each of the chilled water pumps shall be taken on 15 minute intervals 2 week(s) during heating season (OSA temp <40ºF), 2 week(s) during swing season (40ºF < OSA temp < 80ºF), and for 2 week(s) during the cooling season (OSA temp >80ºF) to verify that the chilled water pumps are deactivated in the winter: OSA Temperature, CHWP-1, CHWP-2		

Annual Electric Savings (kWh):	12,968	Contractor Cost ($):	$8,232
Estimated Annual kWh Savings ($):	$736	PBEEEP Provider Cost for Implementation Assistance ($):	$300
		Total Estimated Implementation Cost ($):	$8,532

Estimated Annual Total Savings ($):	$736	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	11.60	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	11.60	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	11	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	4.8%	Percent of Implementation Costs:	5.6%

Findings Details

Building: Rosemount TACC

FWB Number:	13700	Eco Number:	9
Site:	Rosemount TACC	Date/Time Created:	4/5/2012

Investigation Finding:	VFD on chilled water pumps	Date Identified:	12/1/2011
Description of Finding:	Currently the chilled water system is constant primary/constant secondary. The system could be converted to constant primary/variable secondary to reduce pump energy usage when the cooling load on the building is not at design conditions. This effects the following equipment: CHWP-3, CHWP-4 (Note that only one pump runs at a time, the pumps are fully redundant)		
Equipment or System(s):	Pump, secondary CHW (distr-only or evap and distr)	Finding Category:	Variable Frequency Drives (VFD)
Finding Type:	VFD Retrofit - Pumps		

Implementer:	Contractor	Benefits:	Reducing the pump speed when full load is not required will save energy.
Baseline Documentation Method:	Trend data from the chilled water system (Boilerroom – Summer.xls, Boilerroom – Fall.xls, Boiler Room – November.xls, Chiller Loads.xls) showed that there is a large portion of time when the building does not require the full capacity of the chilled water system. Because of this, the speed of the secondary chilled water pumps (CHWP-3 and CHWP-4) can be reduced to more closely match the load.		
Measure:	Install VFD on secondary chilled water pumps		
Recommendation for Implementation:	Contractor shall install 1 VFD and shaft grounding device on each pump motor (two VFDs and shaft grounding kits total based on Danfoss FC102P7K5T4E21H2) and 2 pipe mounted pressure sensors located 3/4 of the way down the secondary chilled water piping system. The contractor shall also modify the VFD programming such that the pumps(s) shall modulate to maintain a differential pressure set point in the secondary chilled water piping system. Only one pump shall operate at a time (pumps are fully redundant) and the VFDs shall be capable of alternating the pumps to ensure even usage. The Contractor shall modify 23 existing air handler 3-way valves to close off the bypass direction.		
Evidence of Implementation Method:	Verification of Implementation shall require: The following trend logs of each of the chilled water system shall be taken on 15 minute intervals 2 week(s) during swing season (40ºF < OSA temp < 80ºF) and for 2 week(s) during the cooling season (OSA temp >80ºF) to verify that the new VFD is properly changing pump speed based on the load: OSA Temperature, CHWP-3 status/speed, CHWP-4 status/speed, Secondary Chilled Water Supply Temp, Secondary Chilled Water Return Temp, Primary Chilled Water Supply Temp, Primary Chilled Water Return Temp		

Annual Electric Savings (kWh):	21,577	Contractor Cost ($):	$14,944
Estimated Annual kWh Savings ($):	$1,211	PBEEEP Provider Cost for Implementation Assistance ($):	$1,500
		Total Estimated Implementation Cost ($):	$16,444

Estimated Annual Total Savings ($):	$1,211	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	13.58	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	13.58	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	18	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	7.9%	Percent of Implementation Costs:	10.9%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

PBEEEP State Government

Building: Rosemount TACC

FWB Number:	13700	Eco Number:	11
Site:	Rosemount TACC	Date/Time Created:	4/5/2012

Investigation Finding:	VFD on hot water pumps	Date Identified:	1/10/2012
Description of Finding:	Currently the heating water system is a constant primary system. Based on trending, there are many times where the load on the boilers is greatly reduced. During those times, the constant volume pumps could be reduced in speed to save energy and still meet the demand on the system. This effects the following equipment: HWP-1, HWP-2 (Note that only one pump runs at a time, the pumps are fully redundant), Boiler-1, Boiler-2		
Equipment or System(s):	Pump, HW distribution	Finding Category:	Variable Frequency Drives (VFD)
Finding Type:	VFD Retrofit - Pumps		

Implementer:	Contractor	Benefits:	Reducing the pump speed when full load is not required will save energy.
Baseline Documentation Method:	Trend data from the hot water system (Boilerroom – Summer.xls, Boilerroom – Fall.xls, Boiler Room –Winter.xls, Boiler Loads.xls) showed that there is a large portion of time when the building does not require the full capacity of the boiler system. Because of this, the speed of the heating water pumps (HWP-1 and HWP-2) can be reduced down to the minimum boiler flow requirements to more closely match the load.		
Measure:	Install VFD on hot water pumps		
Recommendation for Implementation:	Contractor shall install 1 VFD and shaft grounding device on each pump motor (two VFDs and shaft grounding kits total based on Danfoss FC102P7K5T4E21H2) and 2 pipe mounted pressure sensors located 2/3 of the way down the hot water piping system. The contractor shall also modify the VFD programming such that the pumps(s) shall modulate to maintain a differential pressure set point in the hot water piping system. Only one pump shall operate at a time (pumps are fully redundant) and the VFDs shall be capable of alternating the pumps to ensure even usage. The VFDs shall also monitor the return water temperature to ensure that the return water temperature remains above 130ºF to prevent boiler condensation. The Contractor shall modify 23 existing air handler 3-way valves to close off the bypass direction.		
Evidence of Implementation Method:	Verification of Implementation shall require: The following trend logs of each of the heating water system shall be taken on 15 minute intervals 2 week(s) during winter season (OSA temp < 20ºF), 2 week(s) during swing season (40ºF < OSA temp < 80ºF) and for 2 week(s) during the cooling season (OSA temp >80ºF) to verify that the new VFD is properly changing pump speed based on the load: OSA Temperature, HWP-1 status/speed, HWP-2 status/speed, Boiler 1 Supply Water Temperature, Boiler 1 Return Water Temperature, Boiler 2 Supply Water Temperature, Boiler 2 Return Water Temperature,		

Annual Electric Savings (kWh):	80,205	Contractor Cost ($):	$24,504
Estimated Annual kWh Savings ($):	$4,549	PBEEEP Provider Cost for Implementation Assistance ($):	$5,000
		Total Estimated Implementation Cost ($):	$29,504

Estimated Annual Total Savings ($):	$4,549	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	6.49	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	6.49	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	69	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	29.6%	Percent of Implementation Costs:	19.5%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

Building: Rosemount TACC

FWB Number:	13700	Eco Number:	12
Site:	Rosemount TACC	Date/Time Created:	4/5/2012

Investigation Finding:	Existing spaces have manual lighting control.	Date Identified:	1/10/2012
Description of Finding:	There are 22 rooms/spaces in the portions of the building included in the study that currently have manual lighting control that could benefit from automatic motion type controls.		
Equipment or System(s):	Interior Lighting	Finding Category:	Equipment Scheduling and Enabling
Finding Type:	Lighting is on more hours than necessary		

Implementer:	Contractor	Benefits:	Automatic controls only operate the lights when the spaces are occupied.
Baseline Documentation Method:	The existing fixture types and control mechanisms were identified via a facility walkthrough. The hours per day for the individual spaces are based on the data loggers we installed at the facility. This gives us a very conservative light usage for the spaces.		
Measure:	Retrofit existing fixture controls.		
Recommendation for Implementation:	The Contractor shall install ceiling mounted occupancy sensors with dual level switching in nine (9) rooms/spaces in the building [Open office space and conference rooms]. The Contractor shall install occupancy sensors in six (6) rooms/spaces in the building [Hallways on the upper and lower levels]. The Contractor shall install occupancy sensors with dual level switching in seven (7) rooms/spaces in the building [Private offices]. Refer to 12 - Lighting Calcs - v3.1.xls for additional information.		
Evidence of Implementation Method:	Verification of Implementation shall require: Site review to verify retrofit of fixture controls has been completed as required.		

Annual Electric Savings (kWh):	20,804	Contractor Cost ($):	$6,371
Estimated Annual kWh Savings ($):	$1,789	PBEEEP Provider Cost for Implementation Assistance ($):	$2,000
		Total Estimated Implementation Cost ($):	$8,371

Estimated Annual Total Savings ($):	$1,789	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	4.68	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	4.68	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	18	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	11.7%	Percent of Implementation Costs:	5.5%

Findings Details

PBEEEP State Government

Building: Rosemount TACC

FWB Number:	13700	Eco Number:	13
Site:	Rosemount TACC	Date/Time Created:	4/5/2012

Investigation Finding:	No supply temperature reset	Date Identified:	1/11/2012
Description of Finding:	To provide heating and cooling control at the zone level, a low supply temperature is provided at the AHU and zone reheat coils are used to provide heating in the necessary zones. If the supply air temperature is lower than needed to meet zone cooling requirements, additional energy is used to reheat the air being supplied to the zones that do not have a call for cooling. A reset strategy allows the supply air to rise as the cooling load on the system reduces which lowers reheat energy use. The equipment affected is: AHU-15, AHU-21		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Controls (Reset Schedules)
Finding Type:	Supply Air Temperature Reset is not implemented or is sub-optimal		

Implementer:	Contractor	Benefits:	During mild weather, more tempered SAT will save energy.
Baseline Documentation Method:	Trend data from the summer, fall, and winter showed the current supply temperature strategies for the air handlers (Conference Room – Winter.xls, Conference Room – Fall.xls, Conference Room – Summer.xls, Gym – Winter.xls, Gym – Fall.xls, Gym – Summer.xls).		
Measure:	Adjust controls to reset SAT based on OSAT		
Recommendation for Implementation:	For AHU-15: The Contractor shall modify the sequence of operations for this air handler such that the supply air temperature resets based on the outside air temperature. When the OSA temperature is 82ºF or higher the SAT shall be 55ºF. When the OSA temperature is 21ºF or lower the SAT shall be 75ºF. For AHU-21: The Contractor shall modify the sequence of operations for this air handler such that the supply air temperature resets based on the outside air temperature. When the OSA temperature is 82ºF or higher the SAT shall be 62ºF. When the OSA temperature is 21ºF or lower the SAT shall be 80ºF.		
Evidence of Implementation Method:	Verification of Implementation shall require: The following trend logs of each of the affected air handlers (AHU-15 and AHU-21) shall be taken on 15 minute intervals 2 week(s) during winter season (OSA temp < 20ºF), 2 week(s) during swing season (40ºF < OSA temp < 80ºF) and for 2 week(s) during the cooling season (OSA temp >80ºF) to verify that the supply temperature is being reset: OSA Temperature, Supply Air Temperature, Return Air Temperature, Space Temperature, Fan Speed/Status		

Annual Electric Savings (kWh): Estimated Annual kWh Savings ($):	4,265 $367	Annual Natural Gas Savings (therms): Estimated Annual Natural Gas Savings ($):	560 $400
Contractor Cost ($): PBEEEP Provider Cost for Implementation Assistance ($): Total Estimated Implementation Cost ($):	$6,800 $2,000 $8,800		

Estimated Annual Total Savings ($): Initial Simple Payback (years): Simple Payback w/ Utility Co-Funding (years): GHG Avoided in U.S. Tons (C02e):	$766 11.48 11.48 7	Utility Co-Funding for kWh ($): Utility Co-Funding for kW ($): Utility Co-Funding for therms ($): Utility Co-Funding - Estimated Total ($):	$0 $0 $0 $0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	5.0%	Percent of Implementation Costs:	5.8%

PBEEEP Military Affairs – Rosemount TACC

The following list of items does not have a sufficiently short payback to be selected as part of the PBEEEP program. However, if modifications to the various systems are being done for other reasons (maintenance, equipment replacement, etc) then these items could be addressed.

-Air Handler Locations: Though there is no energy savings associated with this, the facility should consider replacing the existing indoor air handling units located in the plenums throughout the building with roof mounted equipment. Currently these units produce significant amounts of noise that is transferred directly to the working spaces. Spot checks during a visit showed noise levels ~ 60 dBA in the offices directly under the units which is above the recommended level for an office area.

-Pump Alternator: Currently the chilled water and heating water pumps are not automatically alternated to even out the wear on any individual pump. At the moment, the only way these pumps are activated/deactivated is through manual disconnect switches. Though there is no energy savings associate with this, we recommend that a pump alternator be installed for each pair of pumps (3 pairs total) to even out the runtime any single pump sees annually.

-Space temperature set points: As part of this project we have recommended space temperature set points as specified by Army Regulation 420-1. The Owner should implement these set points throughout the remainder of the facility (in those spaces not addressed during the PBEEEP study).

-General patching and sealing: Though no major air infiltrations were identified during the site investigations, every building has areas where these leaks tend to develop. We recommend that the Owner (or a Contractor) annually inspect the state of the caulking surround all doors, windows, and other penetrations into the building and replace/patch as needed. A tube of caulking is very cheap and this inspection would be fairly quick. Also, the weather seals on the exterior doors should be inspected annually and these seals should be replaced when they are no longer making good contact with the door. This same annual inspection should also apply to the sealing around the outside perimeter of the building. Though this isn’t for energy reasons, it will prevent water from infiltrating the building and causing damage to the lower level of the building.

-Supply Pressure Reset: The variable volume air handlers (AHUs 8, 12, 13, 14, 15, 16, 22, 23, 24, 25) currently does not utilize supply pressure reset. Supply pressure reset modulates the supply fan speed down until only one VAV box is open to its maximum. This minimizes the amount of fan energy needed during periods of low usage. In order to do this, all of the VAV boxes serving an air handler need to be controlled via a digital BMS. This is not the case with this air handler (the system is pneumatic and each box is an independent controller). Because this would require a new digital BMS be installed, the payback for implementing this falls well outside the PBEEEP program requirements. If a new digital BMS is installed at this site, supply pressure reset control should be added to the control sequence for these air handlers.

-Air balance in lower level restroom/locker-room: On several occasions during our site visits, it was observed that both the men's and women's restrooms on the lower level are very negatively pressurized to the surrounding space. While it is important to keep these spaces negative to control odors, the spaces are so negative that they doors are being held slightly ajar and you can hear the air rushing inside. This could be fixed by rebalancing both the exhaust and supply systems serving these spaces and adding a transfer grille in the doors of each room. Though there is no energy savings associated with correcting this, we recommend this be addressed.

-Water Heater Replacement: The existing four domestic water heaters are not as efficient as they could possibly be (~80% efficient). There are two options for improving the efficiency and performance of this system.

> -Replace with individual high efficiency condensing water heaters: The four individual water heaters could be replaced with four individual high efficiency condensing water heaters (~96%). Due to venting requirements of high efficiency condensing water heaters, the existing flue venting system for the water heaters would need to be replaced. Because of that, all of the water heaters would need to be updated at the same time
>
> -Replace with high efficiency condensing hot water boilers and storage tanks: The four individual water heaters could be replaced with a pair of high efficiency condensing boilers (~94%) and insulated storage tanks. Due to venting requirements of high efficiency condensing water heaters, the existing flue venting system for the water heaters would need to be replaced.

-Motor Runtime: Domestic hot water circulating pump (DCP-1) recirculates hot domestic water throughout the building to ensure that hot water is available fairly quickly when a faucet is used. It runs 24 hours a day even though the facility is not occupied around the clock. This pump could be controlled with a time clock and be turned on during the day (6:00 to 22:00) and be left off at night. If a new digital BMS is installed at this site, control of this pump should be included. Unfortunately, due to the small size of this pump, the payback for installing a time clock (or adding it to a BMS) is beyond the period allowed by the PBEEEP program.

-Automatic faucets: Though there is no energy savings associated with this, we would recommend that automatic or timer controlled lavatory faucets be installed in restrooms throughout the facility. These faucets provide scald protection by limiting the discharge water temperature. They also save water by preventing faucets from being left on. As large portions of this facility are open to the public, this also eliminates potential for vandalism (flooding of restrooms).

-Coil Cleaning: Based on our site visits, very few of the smaller air handlers throughout the facility have access hatches. Because of this we were unable to verify the condition/cleanliness of the heating and cooling coils inside the units. Cleaning air handler coils regularly improves their heat transfer and reduces fan energy (blocked/dirty coils require more fan energy to push air through them). Even with filtration at each unit, dirt still builds on the coils. Adding access hatches to existing air handlers is a tricky proposition and probably shouldn't' be done. We would simply recommend that if any of the air handlers is in need of replacement, that the Owner ensures that replacement units come with access hatches to allow the coils to be cleaned.

-Demand Control Ventilation: Demand control ventilation controls the OSA intake based on the calculated occupancy of a space. This means that only required level of OSA is brought into a space no matter if it is fully or partially occupied. This is an effective means of limiting OSA intake (and therefore saving energy) in spaces where the occupancy density varies greatly. The Classrooms (served by AHU-25) and the Gym (served by AHU-20 and AHU-21) would be ideally suited for this type of OSA control as their occupancy load varies greatly when the space is being used. Unfortunately, adding demand control ventilation to this unit does not provide an acceptable payback within the PBEEEP program.

-Air to air energy recovery: Because of their size, the lower level locker rooms exhaust a very large volume of air whenever that space is in occupied mode (9,580 cfm). This system takes conditioned air from the space (and odors) and exhausts it out of the building. Then (through an air handler) it brings in fresh air to replace what was exhausted. This efficiency of this process could be greatly improved by installing an air to air energy recovery unit on the roof. This unit would use the exhausted air to pre-temper the intake air and greatly reduce the heating/cooling load on the air handler. Unfortunately, due to the limited annual operating hours and the initial cost of the equipment (due to the size need to handle 9,580 cfm), this has a payback of ~20 years which is outside of the PBEEEP program limits.

-Chiller retrofit: At full load (during design days when the outside temperature is >91ºF) the two existing chillers perform nearly as efficiently as new chillers. However, for the majority of the cooling season, the chillers don't often operate at full load. Because of this, replacing the existing chillers with chiller that have a higher IPLV can save energy. IPLV (Integrated Part Load Value) is a measure of how efficient equipment is when it is not operating at full load. Unfortunately, due to the high cost of the equipment, replacing the chillers does not provide a payback within the PBEEEP program requirements. However, if the chillers need to be replaced for other reasons, the Owner should ensure that the new chillers have a high IPLV rating.

-Low Flow Shower Heads: Because it was not possible to accurately track the usage of the showers at the facility, it was not possible to calculate savings to the rigors of the PBEEEP program. We recommend that the Owner check all shower heads installed at the facility and replace them with shower heads that have a maximum flow rate of 1.75 GPM. Lower water flow rates will save on hot water usage, which will in turn save energy.

--Variable Air Volume Control: Currently there are two constant volume air handlers that serve the gym (a large open single room). Because of this, VFDs can be added to the air handler fans. This will allow the system air flow to vary depending on the actual load in the space. This will save energy by more closely matching the air handler performance with the actual space requirements. Unfortunately, due to the small size of the air handlers, this upgrade does not pay back within the PBEEEP program period. If additional work is done to these units (motor replacement, unit replacement, etc) we recommend that the Owner install a VFD on each fan in the system.

-Separate control system: Through an inspection of the equipment on site, we found that each of the two air handler serving the gym has a separate control system. Because of this, the units are not running in sequence properly. While there was no constant measurable energy savings associated with this, we recommend that the Owner have the control system modified so that both of the air handlers share a single controller. Having a single space temperature sensor and time clock responsible for control of the two units, will ensure they operate together properly.

-Outside Air Intake Adjustment: There are several spaces in the building that are in need of adjustment of the intake of Outside Air.

- The Gym (AHU-20 & AHU-21): Only one of these units is bring in outside air. The air handler on the north side is bringing in a small amount of air and the air handler on the south side is bringing in no outside air. Therefore the system is drastically under-ventilating. The units are bringing in a total of 2.5% outside air while the ASHRAE 62.1 ventilation standards require a total of 28%. Due to the variability of the occupancy in this space, we would recommend that a CO2 sensor be installed in this space for control of the OSA intake. This sensor would allow the equipment to vary the intake of OSA to meet the demands of the occupants. Unfortunately, increasing the amount of OSA in this space will not save energy; it will only increase energy usage. It will improve the indoor air quality in the gym and bring the space back up to code requirements.
- Classroom (AHU-25): Based on trending, this unit is over ventilating to some small extent. The amount seems inconsistent and therefore an accurate calculation of the OSA cannot be done to PBEEEP program requirements. If any additional work is done on this air handler, we recommend that the OSA intake at full flow be rebalanced to 17% to save energy and meet code requirements.
- Conference Room (AHU-15): Based on trending, this unit is over ventilating to some small extent. The amount seems inconsistent and therefore an accurate calculation of the OSA cannot be done to PBEEEP program requirements. If any additional work is done on this air handler, we recommend that the OSA intake at full flow be rebalanced to 12% to save energy and meet code requirements.
- Building in general: As the PBEEEP study was limited in scope to only five separate air handlers, the remaining units at the facility we not analyzed. The OSA intake on these units should also be checked versus the ASHRAE 62 code requirements. This would provide the building with the code required OSA intake and limit energy usage as much as possible.

-Heating Water Temperature Reset: Based on trending information collected, it appears that there may be some sort of supply water temperature reset enabled at the boilers. Or at a minimum, a summer/winter supply water temperature set point. Unfortunately, due to weather during the program period, we were unable to determine what the supply water temperature would be during the coldest weather. Because of this, we cannot be certain of the current minimum and maximum supply water temperatures and therefore cannot calculate a savings for adjusting the supply water temperature. We recommend that the Owner checks into the current boiler control package and verify that a supply water reset is enabled. Based on the design documents and equipment information, the supply water temperature should be 180ºF when the outside air temperature is 15ºF or lower and 140ºF when the outside air temperature is 60ºF or above. The controller should also verify that the return water temperature remains above 130ºF to prevent the boilers from condensing. Depending on the current set points, this can save ~$150 annually.

-Gym Air Handler Behavior: Based on our trending, it appears that the two air handlers are not behaving in the same manner. The air handler in the north part of the gym appears to have a constant 67ºF discharge air temperature year round. The air handler on the south part of the gym appears to have a different discharge temperature in the summer (62ºF) and winter (80ºF). The discharge temperature of the north air handler is unusual. It is fairly high to provide cooling/dehumidification during the summer and far too low to provide heating in the space during the winter. Because the chilled water system is off in the winter (therefore no mechanical cooling is being used and the unit is simply circulating air), there is no energy savings associated with correcting this. We do recommend that the control sequence of the north air handler be modified to behave in the same manner as the south air handler.

-Air Handler Supply Temperatures: Data logging shows that many of the units have supply air temperatures that have drifted away from the original design temperatures. While there isn't any energy savings to be had by restoring the original design conditions, the indoor comfort level could likely be improved. If a BMS is installed at the facility as part of this (or another) project, we recommend that the supply air temperature set points from the original design documents be used. We also recommend that the air handler supply temperature set points reset based on the outside air temperature. If the supply air temperature is lower than needed to meet zone cooling requirements, additional energy is used to reheat the air being supplied to the zones that do not have a call for cooling. A reset strategy allows the supply air to rise as the cooling load on the system reduces which lowers reheat energy use.

-VAV Box Minimum Flows: If modifications are made to the ductwork system served by the variable volume air handlers (AHU-15, AHU-16, AHU-25) that require the systems to be rebalanced, the minimum airflow set point for the associated VAV boxes could be reduced (or returned to the original design conditions). By reducing the minimum airflows, at times of temperate weather, the VAV boxes will require less airflow and therefore allow the fan speed of the associated air handlers to be reduced to save energy.

-Variable speed fans speed: Based on trending of the fan motors of the variable speed air handlers, the fan speeds do not vary as much as would normally be expected. We would expect to see fan speeds that range from ~45% to ~85%. However, trending shows these units all hover at ~50% speed with hardly any variation at all (less than 10% up or down). Unfortunately, correcting this will likely increase energy usage at the facility, but improve the comfort level in the space. There are three possible reasons for this:

- First, the fan speed has been artificially limited at the VFD to control noise issues. It is known that there have been noise issues at the facility in the past. It is possible that the speed of these VFDs have been limited to help attenuate the noise issue.
- Second, the duct mounted pressure sensor used for the control of the VFD needs adjustment of has failed. This duct mounted pressure sensor reads the static pressure in the supply ductwork and modulates the fan speed to maintain a specific set point. If this sensor is out of adjustment, or has failed, it cannot properly control the supply static pressure via the fan speed.
- Third, most of the associated VAV box dampers have failed. As individual VAV box dampers close, the static pressure in the ductwork increases. In response to this, the VFD slows the fan speed to maintain a fixed static set point. It is possible that many

of the dampers in the VAV boxes have failed in a mostly closed position and are not modulating. That would cause the low fan speed and limited changes in fan speed.

If a BMS is installed at this facility, all three of the above issues would be addressed as a matter of course. If a BMS is not installed, we recommend that the Owner have these items investigated as they will improve space temperature control. The affect equipment is AHU-15, AHU-16 and AHU-25.

-Energy Recovery Chiller: Currently during the summer, the chillers operate to chill water that is circulated throughout the building to condition the air. Because not every space requires the same level of cooling at the same time, the boilers are used to provide hot water to the local variable volume (VAV) boxes in order to temper the discharge air. A more efficient way of addressing this variable cooling load is through an energy recovery chiller. This type of chiller pulls heat from the chilled water system and instead of rejecting the heat to the outside; it puts it into the hot water system. Doing this, keeps the boilers from operating during the summer, and is a more efficient way to provide reheat to local areas. Unfortunately, there is a significant initial investment in equipment to install and energy recovery chiller and modify the existing chilled and hot water systems. This puts the payback for this item at~17 years which is just outside of the limits of the PBEEEP program. We recommend that when the facility needs to replace the existing chillers (due to end of equipment life or failure) that an energy recovery chiller be installed to reduce the boiler usage during the summer season.

-Alternative Energy: Based on pricing and performance information from recent projects, installing a photovoltaic collection system at the facility does not payback within the PBEEEP Program requirements. The payback calculated is ~30 years. At this point, we cannot recommend a photovoltaic installation at this facility. In the future, as the technology gets more efficient and cheaper, this may change. We also investigated the opportunity for using solar thermal energy recovery at the facility. Unfortunately, there does not appear to be enough usage of heated water (either for space conditioning or domestic hot water) during the summer to provide a payback for this within the PBEEEP Program requirements. As a point of reference, solar water heating has not paid back in less than 20 years for prison facilities (with 100+ inmates). It is therefore highly unlikely that the TACC uses enough hot water to get any reasonable payback (<25 years). Tying into the hydronic system might also be an option, but not with the non-condensing boilers currently installed. The system would have to run at temperatures which would likely cause condensation to be most efficient and that would damage the existing boilers.

It would be helpful for Rosemount TACC to monitor its hot water usage. A possible option is an ultra-sonic meters (e.g. from Dynasonics) for this type of retrofit. There's nothing in the water stream, therefore it requires no pipe cutting to install. Because they aren't in the water stream, they don’t get gummed up by hard water. And they can feed information into a BAS for easy trending.

Here are the ~ square footages for the spaces studied (the total area served by each AHU).
Classroom = 6413 sqft
Conference Room = 5385 sqft
Gym = 9314 sqft
Office = 8236 sqft

Pricing Option 1 (Guard Areas Limited Control): Provide pricing for installation and setup of DDC controls for the following list of systems. See below for individual system control requirements. System shall be capable of integrating with a remote Johnson Metasys control system. The existing pneumatic actuators shall remain and the Contractor shall interface these with the new DDC control system.

- Fourteen (14) Constant Volume Air Handlers
- Six (6) Variable Volume Air Handlers
- Hydronic Heating System
- Chilled Water System

Pricing Option 2 (Guard Areas Full Control): Provide pricing for installation and setup of DDC controls for the following list of systems. See below for individual system control requirements. System shall be capable of integrating with a remote Johnson Metasys control system. The existing pneumatic actuators shall remain and the Contractor shall interface these with the new DDC control system.

- Fourteen (14) Constant Volume Air Handlers
- Six (6) Variable Volume Air Handlers
- Hydronic Heating System
- Chilled Water System
- Eleven (11) Unit/Cabinet Heaters
- Eight (8) Exhaust Fans
- Two (2) Thermostatically Controlled Exhaust Fans
- Thirty-eight (38) VAV Boxes

Pricing Option 3 (Full Building Limited Control): Provide pricing for installation and setup of DDC controls for the following list of systems. See below for individual system control requirements. System shall be capable of integrating with a remote Johnson Metasys control system. The existing pneumatic actuators shall remain and the Contractor shall interface these with the new DDC control system.

- Sixteen (16) Constant Volume Air Handlers
- Ten (10) Variable Volume Air Handlers
- Hydronic Heating System
- Chilled Water System

Pricing Option 4 (Full Building Full Control): Provide pricing for installation and setup of DDC controls for the following list of systems. See below for individual system control requirements. System shall be capable of integrating with a remote Johnson Metasys control system. The existing pneumatic actuators shall remain and the Contractor shall interface these with the new DDC control system.

- Sixteen (16) Constant Volume Air Handlers
- Ten (10) Variable Volume Air Handlers
- Hydronic Heating System
- Chilled Water System
- Sixteen (16) Unit/Cabinet Heaters
- Twenty (20) Exhaust Fans
- Three (3) Thermostatically Controlled Exhaust Fans
- Fifty-eight (58) VAV Boxes

Sequence for Constant Volume Air Handlers:

Each constant volume air handler shall have the following control/monitoring points (and any additional points required for the control sequences):

- Cooling Coil Valve
- Freeze Stat
- Heating Coil Circulation Pump Status
- Heating Coil Valve
- Mixed Air Temperature
- OSA Damper
- OSA Humidity (1 common point for whole building)
- OSA Temperature (1 common point for whole building)
- Relief Air Damper
- Return Air CO2
- Return Air Damper
- Return Air Humidity
- Return Air Temperature
- Space Temperature Sensor
- Supply Air Humidity
- Supply Air Temperature
- Supply Air Smoke Detector
- Return Air Smoke Detector

- Supply Fan Status

Each constant volume air handler shall be capable of the following control sequences/modes
- 100% dry bulb economizer
- Demand control ventilation based on return air CO2
- Morning warm-up/cool-down
- Occupied/Unoccupied modes with unoccupied setback
- OSA damper control based on occupied/unoccupied mode
- Supply air temperature reset based on OSA temperature

Sequence for Variable Volume Air Handlers:

Each variable volume air handler shall have the following control/monitoring points (and any additional points required for the control sequences):
- Cooling Coil Valve
- Freeze Stat
- Heating Coil Circulation Pump Status
- Heating Coil Valve
- Mixed Air Temperature
- OSA Damper
- OSA Humidity (1 common point for whole building)
- OSA Temperature (1 common point for whole building)
- Relief Air Damper
- Return Air CO2
- Return Air Damper
- Return Air Humidity
- Return Air Temperature
- Supply Air Smoke Detector
- Return Air Smoke Detector
- Space Temperature Sensor
- Supply Air Humidity
- Supply Air Temperature
- Supply Air Pressure
- Supply Fan Speed/Status
- High Limit Duct Static Pressure

Each variable volume air handler shall be capable of the following control sequences/modes
- 100% dry bulb economizer
- Constant supply air pressure control
- Morning warm-up/cool-down
- Occupied/Unoccupied modes with unoccupied setback
- OSA damper control based on occupied/unoccupied mode
- Supply air temperature reset based on OSA temperature

Sequence for Constant Volume Exhaust Fans:

Each constant volume exhaust fan shall have the following control/monitoring points (and any additional points required for the control sequences):
- Fan Status

Each constant volume exhaust fan shall be capable of the following control sequences/modes
- Occupied/Unoccupied modes

Sequence for Thermostatically Controlled Constant Volume Exhaust Fans:

Each thermostatically controlled constant volume exhaust fan shall have the following control/monitoring points (and any additional points required for the control sequences):
- Fan Status
- Space Temperature

Each thermostatically controlled constant volume exhaust fan shall be capable of the following control sequences/modes
- Occupied/Unoccupied modes with unoccupied setback

Sequence for Unit Heaters and Cabinet Unit Heaters:

Each unit heater/cabinet unit heater shall have the following control/monitoring points (and any additional points required for the control sequences):

- Fan Status
- Heating Coil Valve
- Space Temperature

Each unit heater/cabinet unit heater shall be capable of the following control sequences/modes

- Occupied/Unoccupied modes with unoccupied setback

Sequence for VAV Boxes with Reheat:

Each VAV box shall have the following control/monitoring points (and any additional points required for the control sequences):

- Damper Position
- Reheat Coil Valve
- Space Temperature
- VAV Box Airflow

Each VAV box shall be capable of the following control sequences/modes

- Occupied/Unoccupied modes with unoccupied setback
- Add supply pressure reset based on VAV box damper positions to control sequence of associated air handler
- Add supply air temperature reset based on VAV space temperature sensors to control sequence of associated air handler

Sequence for Hydronic Heating System:

Each part of the hydronic heating system shall have the following control/monitoring points (and any additional points required for the control sequences):

- Boiler Inlet Water Temp (x2)
- Boiler Outlet Water Temp (x2)
- Boiler Status (x2)
- Combustion Air Intake Damper Position
- Heating Water Pump Status (x2)

Each part of the hydronic heating system shall be capable of the following control sequences/modes

- Pump alternator
- Boiler alternator
- Heating water temperature reset based on OSA temperature.

Sequence for Chilled Water System:

Each part of the chilled water system shall have the following control/monitoring points (and any additional points required for the control sequences):

- Chiller Inlet Water Temp
- Chiller Outlet Water Temp
- Chiller Status (x2)
- Chilled Water Pump Status (x4)

Each part of the chilled water system shall be capable of the following control sequences/modes

- Pump alternator
- Chilled water temperature reset based on OSA temperature.

Matthew Armstead

From: Roy Crist
Sent: Thursday, December 01, 2011 10:55 AM
To: Matthew Armstead
Subject: FW: Budget pricing
Attachments: image001.jpg; ATT00001.txt

Here is Rosemount pricing from System One controls.

Roy Crist, CCCA, Construction Field Consultant
651-632-2362 (direct), 651-248-2190 (cell); rcrist@eeaengineers.com EEA Ericksen Ellison & Associates, Inc.
305 2nd Ave. NW; Suite 105; New Brighton, MN 55112, 651-632-2300 Please consider the environment before printing

-----Original Message-----
From: Don Smith [mailto:don.smith@peoplesco.com]
Sent: Thursday, December 01, 2011 9:09 AM
To: Roy Crist
Cc: Bill Gausman
Subject: Re: Budget pricing

Roy:

Here are some BAS budgeting $$ based on the outline information you provided for the NG Rosemont facility. These make the following assumptions:

1. Existing controls to be removed and replaced with new BAS/DDC devices.
2. New wiring wherever needed for new duct and room sensors, damper and valve actuators, etc.
3. Replace existing VAV box controls with new DDC components, including valves. Does NOT include valve replacement piping work by mechanical contractor. Assumes one valve per VAV box.
4. No front-end work for central JCI monitoring and directly related work. new BAS will have industry standard LON or BACnet reporting to JCI.

Option 1 - $ 346,800
Option 2 - $ 427,600
Option 3 - $ 434,500
Option 4 - $ 467,200

GIve me a call to go over these budgets and included work.

Don Smith
don.smith@peoplesco.com

Matthew Armstead

From: Robert.J.Nagengast@jci.com
Sent: Tuesday, December 06, 2011 3:45 PM
To: Roy Crist
Cc: Matthew Armstead
Subject: RE: Budget pricing for Control work

Roy,
Below are the budgets that I came up with. Please do not hesitate to contact me if you have any other questions.

Option #1 = $480,000
Option#2 = $590,000
Option #3 = $598,000
Option #4 = $750,000

Thanks,

Rob Nagengast, LEED AP
Account Executive
Johnson Controls
2605 Fernbrook Lane N,
Suite T
Plymouth, MN 55447

Tel : 763-585-5069
Fax: 763-566-2208
Mobile: 612-616-8937
Email : robert.j.nagengast@jci.com

From: Roy Crist <rcrist@eeaengineers.com>
To: "Robert.J.Nagengast@jci.com" <Robert.J.Nagengast@jci.com>
Cc: Matthew Armstead <marmstead@eeaengineers.com>
Date: 11/29/2011 08:14 AM
Subject: RE: Budget pricing for Control work

That will work.
Thanks
Roy Crist, CCCA, Construction Field Consultant
651-632-2362 (direct), 651-248-2190 (cell);
rcrist@eeaengineers.com
EEA Ericksen Ellison & Associates, Inc.
305 2nd Ave. NW; Suite 105; New Brighton, MN 55112, 651-632-2300
Please consider the environment before printing

From: Robert.J.Nagengast@jci.com [mailto:Robert.J.Nagengast@jci.com]
Sent: Tuesday, November 29, 2011 8:12 AM
To: Roy Crist

Cc: Matthew Armstead
Subject: Re: Budget pricing for Control work

Thanks for the inquiry. If I have something to you by first part of next week, is that acceptable?

Thanks,

Rob Nagengast, LEED AP
Account Executive
Johnson Controls
2605 Fernbrook Lane N,
Suite T
Plymouth, MN 55447

Tel : 763-585-5069
Fax: 763-566-2208
Mobile: 612-616-8937
Email : robert.j.nagengast@jci.com

From:	Roy Crist <rcrist@eeaengineers.com>
To:	Rob Nagengast <Robert.J.Nagengast@jci.com>
Cc:	Matthew Armstead <marmstead@eeaengineers.com>
Date:	11/28/2011 07:24 AM
Subject:	Budget pricing for Control work

Rob
We are working on an energy study project and have developed a series of recommendation for the owner. I have attached a copy of the BAS requirements that we need to get budget pricing from you on. This would extend the JCI system for the MN National Guard to their Rosemount facility. As usual we need the budget pricing to complete our study. Please review the attachment, let us know if you have any questions and get us some budget pricing as quickly as you can.
Regards,
Roy Crist, CCCA, Construction Field Consultant
651-632-2362 (direct), 651-248-2190 (cell);
rcrist@eeaengineers.com
EEA Ericksen Ellison & Associates, Inc.
305 2nd Ave. NW; Suite 105; New Brighton, MN 55112, 651-632-2300
Please consider the environment before printing

Findings Details

Building: Rosemount TACC

FWB Number:	13700	Eco Number:	8
Site:	Rosemount TACC	Date/Time Created:	3/14/2012

Investigation Finding:	Reduce occupied OSA intake	Date Identified:	12/1/2011
Description of Finding:	Currently the equipment brings in more outside air than is required by ASHRAE 62 for ventilation purposes. This is due to current BMS programming. The equipment affected is: AHU-15, AHU-25		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Deleted
Finding Type:	Finding Deleted by Provider		

Implementer:	None	Benefits:	None
Baseline Documentation Method:	Trending of the air handlers (Conference Room – Summer.xls, Classroom – Summer.xls, Conference Room – Fall.xls, Classroom – Fall.xls) allowed the current OSA intake to be calculated. Comparing these values to the calculated ASHREA 62.1 ventilation requirements (ASHRAE OSA Calcs - Rosemont TACC.xls) showed that these spaces are over ventilated.		
Measure:	After further investigation, this calculation no longer pays back within the PBEEEP program requirements and has been eliminated.		
Recommendation for Implementation:	None		
Evidence of Implementation Method:	After further investigation, this calculation no longer pays back within the PBEEEP program requirements and has been eliminated.		

Estimated Annual Total Savings ($):	$0	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.00	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.00	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	0	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.0%	Percent of Implementation Costs:	0.0%

Findings Details

Building: Rosemount TACC

FWB Number:	13700	Eco Number:	10
Site:	Rosemount TACC	Date/Time Created:	3/14/2012

Investigation Finding:	Install energy recovery chiller to reduce boiler use in summer reheat	Date Identified:	12/1/2011
Description of Finding:	During the summer, when any space is overly cool, the air handler or VAV box opens the valve on its heating coil to raise the space temperature up. Currently this heat comes from the gas fired boilers. During the summer, only a single boiler cycles on at the lowest fire rate to meet the reheat demand. Because the boiler fire rate can only go so low (typically ~20%) the boiler will cycle on and off several times per hour to meet the demand. A more efficient method would be to install an energy recovery chiller. A normal chiller takes heat from the chilled water system and rejects it to the outside. An energy recovery chiller will take heat from the chilled water system an reject it to the heating water system. Thus reducing the need for the boilers during the cooling season. This effects the following equipment: Chiller 1, Chiller 2, Boiler 1, Boiler 2,		
Equipment or System(s):	Chiller Plant	Finding Category:	Deleted
Finding Type:	Finding Deleted by Provider		

Implementer:	N/A	Benefits:	Upon further investigation, this measure does not pay back within the PBEEEP Program requirements. No further investigation needed.
Baseline Documentation Method:	Trend data from the chilled water system and heating water system during the summer (Boilerroom – Summer.xls, Boilerroom – Fall.xls, Boiler Room – November.xls, Chiller Loads.xls, Boiler Loads.xls) showed that it was possible to add a new energy recovery chiller that will limit the amount of time that the existing boilers would need to run for the purpose of providing reheat during the summer.		
Measure:	Upon further investigation, this measure does not pay back within the PBEEEP Program requirements. No further investigation needed.		
Recommendation for Implementation:	Upon further investigation, this measure does not pay back within the PBEEEP Program requirements. No further investigation needed.		
Evidence of Implementation Method:	N/A		

Estimated Annual Total Savings ($):	$0	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.00	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.00	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	0	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.0%	Percent of Implementation Costs:	0.0%

Findings Details

Building: Rosemount TACC

FWB Number:	13700	Eco Number:	14
Site:	Rosemount TACC	Date/Time Created:	3/14/2012

Investigation Finding:	Boiler Flue Economizer	Date Identified:	1/23/2012
Description of Finding:	The current boilers are non-condensing. Meaning that the efficiencies of the boilers is ~80%. A fully condensing boiler would have efficiencies ~94%. Replacing the boilers for higher efficiency boilers does not payback within the PBEEEP program. However, a boiler flue economizer could be installed to save energy. A boiler flue economizer is a device that extracts extra heat from the flue gasses of the boiler. This improves the efficiency of the boiler system by saving energy from the flue that would normally be vented from the building. This effects the following equipment: Boiler 1, Boiler 2		
Equipment or System(s):	Boiler Plant	Finding Category:	Deleted
Finding Type:	Finding Deleted by Provider		

Implementer:	N/A	Benefits:	Upon further investigation, this measure does not pay back within the PBEEEP Program requirements. No further investigation needed.
Baseline Documentation Method:	Visual inspection of the equipment and manufacture's information shows what the current efficiency of the boiler system is and what potential there is for the economizer.		
Measure:	Upon further investigation, this measure does not pay back within the PBEEEP Program requirements. No further investigation needed.		
Recommendation for Implementation:	Upon further investigation, this measure does not pay back within the PBEEEP Program requirements. No further investigation needed.		
Evidence of Implementation Method:	Upon further investigation, this measure does not pay back within the PBEEEP Program requirements. No further investigation needed.		

Estimated Annual Total Savings ($):	$0	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.00	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.00	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	0	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.0%	Percent of Implementation Costs:	0.0%

Xcel Energy®

414 Nicollet Mall, GO-6
Minneapolis, MN 55401

1-800-481-4700
xcelenergy.com

December 27, 2011

Bob Jeffries
MN Dept of Military Affairs
13885 S Robert Trail
Rosemount, MN 55068

Dear Bob :

Thank you for participating in Xcel Energy's Recommissioning program. We have reviewed your study application and proposal and have preapproved your study. The following outlines your rebate and project information:

Building Address	**13885 S Robert Trail**		
Study Cost	$46,600	Study Number	**RM1744**
Preapproved study rebate*	**$24,875**		
* Your rebate was based on the study cost provided. If the final study cost is lower, your rebate will be adjusted accordingly.			
Study Provider	**Ericksen Ellison and Associates**		
Account manager	**Barb Jerhoff** Phone **651-229-5565**		

Here's a quick review of the Recommissioning program process:

- Once your study is complete, your study provider will send a draft copy to us for review.
- After we complete our review and approve the study, we will send you a confirmation letter noting our approval.
- Your study provider will schedule a wrap-up meeting with you and your Xcel Energy account manager to go over the results of the study.
- You pay the study provider for the full cost of the study.
- You submit the Recommissioning Study Rebate Application, along with a copy of the invoice and your Customer Implementation Plan, to us within 3 months of your report presentation. Please work with your account manager to complete the Customer Implementation Plan.
- We'll send your study rebate check to you.

Xcel Energy®

414 Nicollet Mall, GO-6
Minneapolis, MN 55401

1-800-481-4700
xcelenergy.com

Please note that we need to approve the final study in order to receive your study rebate.

This study pre-approval is valid for **3 months** from the date of this letter. If your study will take longer than that, please let us know. If you have any questions or comments, please call your assigned Xcel Energy account manager. Thanks again for participating in our Recommissioning program.

Sincerely,

Alex Birkholz
Marketing Assistant, Recommissioning

Attachment

CC: Barb Jerhoff - Xcel Energy
Sherryl Volkert - Xcel Energy
Matt Armstead - Ericksen Ellison and Associates

PBEEEP
State Government

Public Buildings Enhanced Energy Efficiency Program

SCREENING RESULTS FOR
ROSEMOUNT NATIONAL GUARD TACC

Date: 11/3/2010

1.0 Screening Summary

The goal of screening is to select buildings where an in-depth energy investigation can be performed to identify energy savings opportunities with relatively short (1 to 5 years) and certain payback periods. The screening process assesses the potential to produce a technically and economically viable energy savings project in the Investigation Phase. The screening of Rosemount National Guard TACC was performed by the Center for Energy and Environment (CEE) with the assistance of the facility staff. A building walk-through was conducted on October 22, 2010. Additionally, interviews with the facility staff were carried out. These activities were completed to document the status and current conditions of the energy consuming equipment in determining potential for comprehensive recommissioning. This report is the result of the screening process.

Rosemount National Guard Training and Community Center TACC) is a 2 story, 99,522 interior square foot facility used by the active National Guard troops as well as for community functions. There is an attached building which is leased to the City of Rosemount. The utilities are shared and bills are pro-rated.

Table A: Site Summary

Facility Name	Rosemount National Guard TACC
Location	13865 S Robert Trail, Rosemount, MN 55068
Facility Manager	Bob Jeffries
Number of Buildings	1
Interior Square Footage	99,522
PBEEEP Provider	Center for Energy and Environment (Gustav Brändström)
Date Visited	10/22/2010
Annual Energy Cost	$ 108,057
Annual Energy Usage	816,308 kWh (electric) 60,850 Therms (natural gas)
Utility Company	Xcel Energy (electricity), MN Energy Resources (natural gas)
Site Energy Use Index (EUI)	96.6 kBtu/sq. ft.
Benchmark EUI (from B3)	102.2 kBtu/sq. ft.

Table B: Building Summary

Building Name	State ID	Area (Square Feet)
Main Building	P01C6708001	99,522

Mechanical Equipment
The building contains two boilers and two chillers. There are a total of 24 hot water pumps and 4 chilled water pumps.

There are a total of 32 AHUs. Each unit is separately controlled. The units are generally mounted in the ceiling space above individual rooms, and have an associated control box, including an analog time clock that is also in the ceiling space. The timers and controls are difficult to access and therefore are rarely adjusted by the staff. Because the clocks often have the incorrect time of day, the spaces tend to be set for a constant temperature 24 hours a day, seven days a week. There are a total of approximately 71 VAV boxes associated with these AHUs, most of the VAVs contain reheats.

The following table lists the key mechanical equipment for the building.

Table C: Mechanical Equipment Summary

Quantity	Equipment
32	Air Handlers
71	VAV Boxes
43	Exhaust Fans
2	Chiller – Electric, Air-cooled
4	Chilled Water Pumps
2	Hot Water Boiler – Natural Gas, New Burners for dual fuel
24	Hot Water Pumps

Controls and Trending
There is no Building Automation System (BAS). The spaces designated for study will require data logging by the provider to understand their operation.

Lighting
Indoor lighting- Interior lighting consists of mainly T8 32 watt which are controlled by switches.

Energy Use Index B3 Benchmark
The site Energy Use Index (EUI) for the building is 97 kBtu/sqft, which is 5% lower than the B3 Benchmark of 102 kBtu/sqft. The site EUIs for State of Minnesota buildings are 23% lower than their corresponding B3 Benchmarks on average.

Metering
There are two electrical meters and one gas meters. Because the utilities are shared with the City of Rosemount's Ice Arena (attached) the meter readings are prorated by the two tenants.

Documentation
The complex has a large amount of documentation. It is not organized very well; however there are electronic copies of many of the prints for projects which were done at the campus which helps in finding information on building on equipment within the complex.

2.0 Recommendations for Investigation Phase:

An energy study of specific spaces within the building, typical of the entire facility is recommended at this time. The reason for a limited investigation is due to:

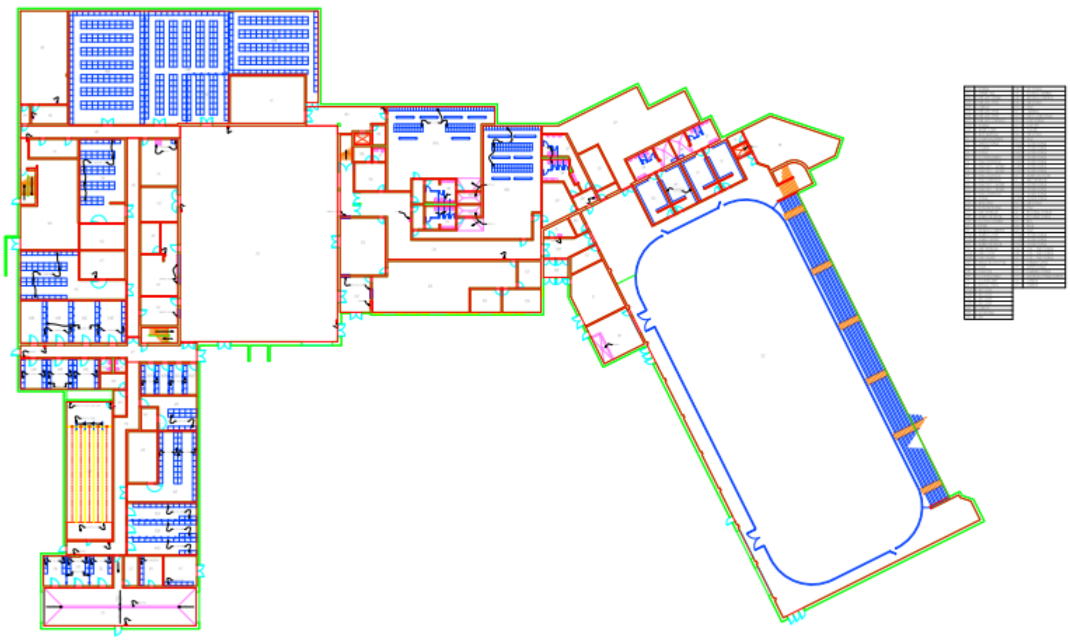
- limited equipment controls for optimization and equipment/systems central management
- Limited access to air handling units (AHU) located above the ceiling

Taking into consideration the costs to investigate equipment under limited controls and the costs to investigate the AHUs, a full investigation of this site would not be cost-effective. An investigation according to the PBEEEP guidelines will result in an evaluation of the potential benefit of installing a DDC building automation system is installed.

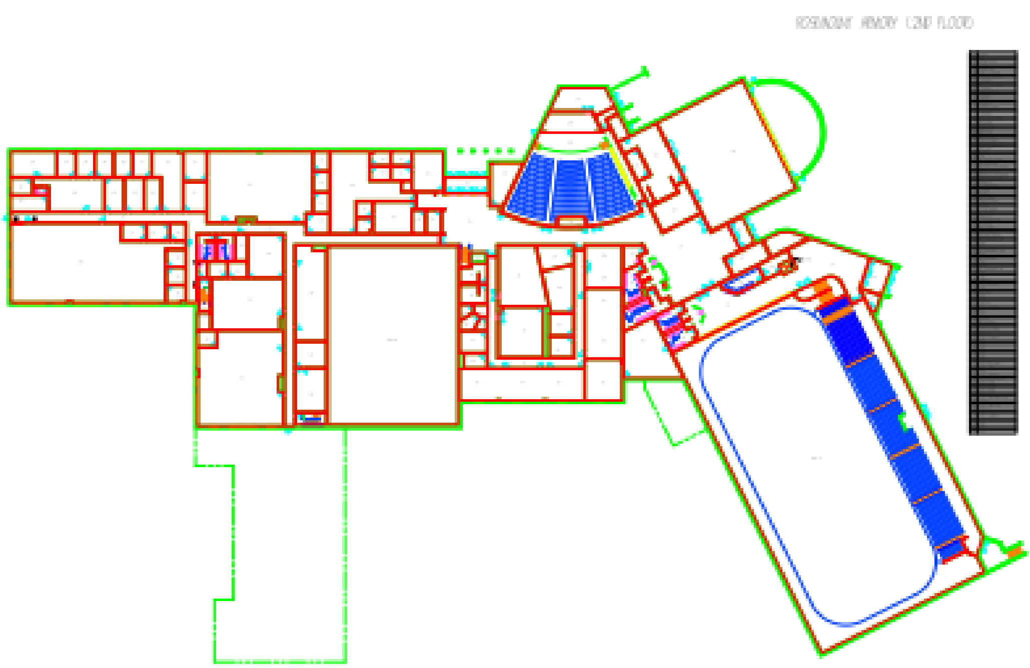
Based on the equipment at Rosemount National Guard TACC, the following opportunities should be considered in the study, and for their potential to be implemented throughout the facility:

- Adjust air handler and exhaust fan operation schedules to match occupancy and reduce run-time
- Optimization of air handler economizer control to prevent excessive outside air intake and ensure adequate ventilation
- Implement discharge air temperature reset control of air handlers to reduce heating and cooling loads
- Implement hot water reset control for hot water boilers to reduce natural gas use
- Implement chilled water reset control for chillers to reduce energy use
- Investing in DDC controls, which would promote greater flexibility in scheduling and improve control of the air handling equipment. With DDC, several modes of operation would be programmable, which is a beneficial option for sites with varied occupancy such as Rosemount National Guard TACC

Building Plans



Lower Floor



Main Floor